EU RO Mutual Recognition Technical Requirements

LV TRANSFORMERS	Version	0.3
	Adoption Date	1 April 2016
	Application Date	1 October 2016
	Tier	1
This document is subject to controlled issue and can be found here: http://www.euromr.org/technical-requirements ***** Uncontrolled if downloaded or printed *****		

1. PRODUCT DESCRIPTION

1.a General description of the product

a) This technical requirement applies to three-phase power transformers rated at greater than 5 kVA and single phase power transformers rated at greater than 1 kVA (including auto-transformers), up to a power limit of 50k VA **(50k VA when single phase)**;
b) This technical requirement does not apply to special transformers as per IEC 60076 -1;
c) This technical requirement does not apply to the special transformers intended for Ice Breakers and ships with an ice class, on high-speed crafts, on ships with nuclear power plant and on other special objects with more severe environmental conditions or where raised reliability of the equipment is required.

1.b Application limitations

Transformers shall be used in low voltage (<1000V AC systems) electrical installations of ships and off shore units classed for unrestricted navigation if, designed, constructed and tested to operate satisfactorily under the worst environmental conditions, found on board, for each application case.

LV TRANSFORMERS	Version	0.3
	Adoption Date	1 April 2016
	Application Date	1 October 2016
	Tier	1
This document is subject to controlled issue and can be found here: http://www.euromr.org/technical-requirements ***** Uncontrolled if downloaded or printed *****		

1.c Intended use

Nil

1.d System context

Nil

2. DESIGN EVALUATION

2.a Engineering evaluation requirements

2.a i. Technical Requirements

a) All transformers, except those used for motor starting, shall be double wound, with no electrical connections between primary and secondary windings;
b) Transformers shall be of the dry and air cooled type;
c) Acceptance of liquid immersed type transformers is subject to special consideration by the EU RO on a case-by-case basis. Liquid-immersed transformers should be in compliance with the requirements as below：
   I. Liquid fillings for transformers shall be non-toxic and of a type which does not readily support combustion. Such transformers shall have a pressure release device with an alarm and there shall be a suitable means provided to contain any liquid which may leak from the transformer due to the operation of the release device or damage to the tank;
   II. Where forced liquid cooling is used, there shall be temperature monitoring of the cooling medium and transformer windings with an alarm being given when the temperature exceeds a preset limit, and provision shall be made for reducing the load to a level commensurate with the cooling available;
   III. The construction shall be such that the liquid is not spilled in inclined position; a liquid gauge indicating the normal liquid level range shall be fitted;
   IV. The voltage drop of transformers supplying secondary distribution systems from no load to rated load at resistive load shall not exceed the following:

- 2.5% for single phase transformers rated more than 5 kVA or 3-phase transformers rated more than 15 kVA;
- 5% for single phase transformers rated up to 5 kVA or 3-phase transformers rated up to 15 kVA;

V. The temperature rise of transformers at windings is not to exceed the values given in **Table 1** during continuous operation at rated output, where the ambient air temperature is based on 45℃.

Table 1

Limit of Temperature Rise			
Type of transformers	Limit of temperature rise(K) windings		Method of measurement
Dry-type air-cooling transformers	Class A insulation	50	Resistance method
	Class E insulation	65	
	Class B insulation	75	
	Class F insulation	95	
	Class H insulation	120	
Liquid-immersed transformers	Identified as ON.. or OF.. in IEC60092-303	65	Thermometer or thermocouple
	Identified as OD.. in IEC60092-303	70	
• All transformers are to be capable of withstanding, without damage, the thermal and mechanical effects of a short-circuit at the terminals of any winding for 2 s. • Transformers are to be subjected to high voltage test according to the table showing below, applying a test voltage between primary and secondary windings and between windings and			

the earthed enclosure for 1 min without breakdown and flashover.			

Voltage of High Voltage Test	
Highest voltage （root-mean-square) kV	Rated short duration power frequency withstand voltage （root-mean-square） kV
⩽1.1	3
3.6	10
7.2	20
12.0	28
17.5	38
24.0	50
36.0	70

VI. Transformers are to withstand an induced high voltage test with a voltage twice the rated voltage. The duration of the test is to be 1 min with a frequency less than or equal to twice the rated frequency. If the frequency is greater than twice the rated frequency, the duration of the test is to be obtained from the following formula with a minimum of 15 s:

t = (60 × 2 × rated frequency) / test frequency (s)

VII. For transformers subject to temperature rise test, the induced high voltage test is to be carried out immediately after the temperature rise test;

VIII. Suitable terminals, clearly marked, shall be provided in an accessible position, convenient for external connections. The terminals shall be effectively secured and shall be so spaced and/or shielded that they cannot be accidentally earthed, short-circuited or touched;

IX. Transformers should be fitted with an earth terminal for the connection of a protective conductor. All exposed metallic conductive non-live parts should be connected to the earth terminal by construction or otherwise. Marine transformers with metal enclosures should be in compliance with the above-mentioned standards an in addition, the following requirements:

- Metal enclosures shall be of sufficient mechanical strength for mechanical protection, normal operation and safe handling of transformers;
- Metal enclosures shall have sufficient space to maintain enough air clearance and creepage distance between conducting parts and between conducting parts and non-conducting parts of transformers inside metal enclosures. When a transformer mounted in the metal enclosure is in normal operation, the temperature rise shall comply with **Table 1**;
- Degree of protection provided by metal enclosures should be appropriate to the ambient conditions of the location where transformers are installed;
- The temperature rise of transformer mounted in metal enclosure in normal operation shall comply with the aforementioned limits.

2.a.ii. Technical documents to be submitted

IMPORTANT: The English Language shall be used for all submitted documents.

a) General drawings / plans;
b) Detailed drawings of main parts including frames, primary windings, secondary windings, magnetic cores (with type / model of the main material such as electromagnetic wire, silicon steel sheet, insulation material, etc.);
c) Detailed construction drawings of metallic enclosure if any）;
d) Nameplate drawings;
e) External connection terminal drawings;
f) Product specifications;
g) Type test plan;
h) Installation manual;
i) Process flow diagram with quality reference point marking.

2.b Type testing requirements

a) Test specimens shall be taken from the production line or from stocks†;
Tests shall be carried out in Laboratories recognized by the EU RO or in the presence of the EU RO Surveyor. In cases where the tests are conducted at

Nationally Accredited Laboratories, the presence of the EU RO surveyor may be omitted†;

b) Unless otherwise specified, all tests are to be carried out under the following atmospheric conditions:
   i. Ambient temperature between 10℃ and 40℃ and with cooling water (if required) at any temperature not exceeding 25℃;
   ii. Relative humidity：30％RH～90％RH;
   iii. Air pressure：86～106 kPa.
   iv. As a minimum, type test of marine transformers shall be in accordance with **Table 2**:

Table 2

Test items	Requirements	Test method
Dielectric strength test	Clause 2.a.i of this part	IACS UR E10
Measurement of insulation resistance	IACS UR E10	IACS UR E10
Voltage regulation test	Clause 2.a.i of this part	Clause 2.1.1 3 of this part
Temperature-rise measurement	Clause 2.a.i of this part	IEC60076-2
Secondary terminal short-current test	Clause 2.a.i of this part	IEC60076-5
Degree of protection (for transformers with enclosure)	IP××	IEC60529
Damp heat test	IACS UR E10	IEC60068-2-30
Salt mist test	IACS UR E10	IEC60068-2-52
Measurement of winding resistance	Clause 15 of IEC60076-11	
Measurement of voltage ratio and vector	Clause 16 of IEC60076-11	
Measurement of impedance voltage , short-circuit imp. and load loss	Clause 17 of IEC60076-11	
Measurement of no-load loss and current	Clause 18 of IEC60076-11	
Dielectric tests	Clause 19 and 20 of IEC60076-11	

Measurement of zero-sequence impedance of 3 phase transformers	Clause 8.7 of IEC60076-11	
Measurement of harmonics of the no-load current functional test of supplement elements, if any (PT 100, cooling fans, protection devices etc.)	Clause 8.6 of IEC60076-11	

† For further clarification of witnessing of tests and sampling the test specimen(s), refer to paragraphs 6, 7 and 8 of the EU RO "Design Evaluation Scheme" procedure (Appendix V of EU RO Framework Document for the Mutual Recognition of Type Approval found on http://www.euromr.org/Guidance%20for%20Mutual%20Recognition).

3. PRODUCTION REQUIREMENTS

a) A basic production site, suitable product equipment and measurement equipment, and practical process documentation shall be provided by the manufacturer to ensure that the transformers comply with the drawings and technical documents approved by the EU RO;
b) A Quality Management System meeting the requirements of the EU RO "Product Quality Assurance (PQA)" procedure (Appendix VI of EU RO Framework Document for the Mutual Recognition of Type Approval);
c) The source of main material such as silicon steel sheet, electromagnetic core, insulation material, etc. shall be controlled effectively by the manufacturer to ensure the type / model is in compliance with the drawings and documents approved by the EU RO;
d) All of the silicon steel sheets shall have the same magnetic aligning for high magnetic permeability core;
e) The tests indicated below shall be carried out by manufacturer
    I. Observational check;
    II. Measurement of winding resistance(Clause 15 of IEC60076-11);
    III. Measurement of voltage ratio and check of phase displacement (Clause 16 of IEC60076-11);

IV. Measurement of short-circuit impedance and load loss(Clause 17 of IEC60076-11);
V. Measurement of no-load loss and current(Clause 18 of IEC60076-11);
VI. Separator-source AC withstand voltage test (Clause 19 of IEC60076-11);
VII. Induced AC withstand voltage test (Clause 20 of IEC60076-11);
VIII. High voltage test ①②(IACS UR E10);
IX. Insulation resistance measurement (IACS UR E10) ;
X. Partial discharge measurement (when Um≥3.6kV) (Clause 22 of IEC60076-11);
XI. Voltage regulation test ③ (Clause 2.1.1.3 of this part),
XII. Measurement of temperature rise ④ (Clause 2.1.1.4 of this part).

Notes：

① For transformers subject to temperature rise test, the high voltage test shall be carried out immediately after the temperature rise test;
② The high voltage test is, in general, not to be repeated but if it is necessary, one additional test is permitted to be carried out with a test voltage equal to 75% of the voltage at the first test;
③ If the test is impracticable at the manufacturer's site (such as the manufacturer's power distribution is limited, etc.), it may be waived, subject to agreement of EU RO;
④ The test should only be carried out to the first product for batch products of the same type and specification.

4. MARKING REQUIREMENTS

4.1 Each transformer shall be provided with a clear symbol or mark near the terminals for external connections. A clear earthing mark shall be provided near the earthing terminal. The entry shall indelibly marked;

4.2 Each transformer shall be provided with a rating plate of weatherproof material, fitted in a visible position, showing the items indicated as below. The entries

on the plate shall be indelibly marked (that is, by etching, engraving, stamping or by a photo-chemical process).

a) Kind of transformer;
b) Number and year of product standard;
c) Manufacturer's name;
d) Manufacturer's serial number;
e) Year of manufacture;
f) Insulation system temperature for each winding. The first letter shall refer to the high voltage winding, the second letter shall refer to the low voltage winding. When more than two windings are present, the letters shall be placed in the order of the windings from the high voltage to the low voltage;
g) Number of phases；
h) Rated power for each kind cooling;
i) Rated frequency；
j) Rated voltages, including tapping voltages, if any;
k) Rated currents for each kind cooling;
l) Connection symbol;
m) Short-circuit impedance at rated current and at the appropriate referenced temperature;
n) Type of cooling;
o) Total mass;
p) Insulation levels;
q) Degree of protection;
r) Environmental class;
s) Climatic class;
t) Fire behaviour class.

The rated withstand voltages for all windings shall appear on the rating plate. The principles of the standard notation are illustrated in Clause 5 of IEC60076-3.

4.3 Each transformer enclosure shall be provided with a rating plate of weatherproof material, fitted in a visible position, showing the items indicated in 4.1 above. The entries on the plate shall be indelibly marked (that is, by etching, engraving, stamping or by a photo-chemical process).

LV TRANSFORMERS	Version	0.3
	Adoption Date	1 April 2016
	Application Date	1 October 2016
	Tier	1
This document is subject to controlled issue and can be found here: http://www.euromr.org/technical-requirements ***** Uncontrolled if downloaded or printed *****		

5. TYPE APPROVAL CERTIFICATE CONTENT

The EU RO MR Type Approval Certificate shall contain the minimum information as defined in the EU RO Framework Document for the Mutual Recognition of Type Approval - see Appendix I EU RO MR Type Approval Certificate Information.

The following information is specifically applicable to products relevant to this technical requirement and shall be included on the relevant EU RO MR Type Approval Certificate:

a) Insulation level;
b) Cooling method;
c) Degree of protection of enclosure (if any);
d) Rated power;
e) Primary/secondary voltage;
f) Coupling index, etc.

6. APPROVAL DATE AND REVISION NUMBER

Date	Revision	Comment
8 July 2012	0.0	Accepted by Advisory Board
31 January 2014	0.1	Updated as per CRF003, Reference to EU RO Framework Document for the Mutual Recognition of Type Approval added.
31 January 2015	0.2	CRF018 – Revision to par. 2.a.ii - Technical documents to be submitted in English; CRF020 – Revision to par. 5 - 'Type Approval Certificate Content'.
1 April 2016	0.3	CRF025 – Updated to new MR TR document format incl. par. 8; CRF026/026a – Witness testing & control of test specimen; CRF028 – addition of 6 month application clause.

7. BACKGROUND INFORMATION / REFERENCES

a) IEC60092-303 ed3.0 (1980-01), Electrical installations in ships. Part 303: Equipment - Transformers for power and lighting;
b) IEC 60092-303-am1 ed3.0 (1997-09), Amendment 1 - Electrical installations in ships. Part 303: Equipment - Transformers for power and lighting;

LV TRANSFORMERS	Version	0.3
	Adoption Date	1 April 2016
	Application Date	1 October 2016
	Tier	1
This document is subject to controlled issue and can be found here: http://www.euromr.org/technical-requirements ***** Uncontrolled if downloaded or printed *****		

c) IEC 60076-1(2000-04) , Power transformers - Part 1: General;
d) IEC 60076-2(1993-04) , Power transformers - Part 2: Temperature rise;
e) IEC 60076-3(2000-03) , Power transformers - Part 3: Insulation levels, dielectric tests and external clearances in air;
f) IEC 60076-4(2002-06) , Power transformers - Part 4: Guide to the lightning impulse and switching impulse testing - Power transformers and reactors;
g) IEC 60076-5(2006-02) , Power transformers - Part 5: Ability to withstand short circuit;
h) IEC 60076-10(2005-07) , Power transformers - Part 10: Determination of sound levels;
i) IEC 60076-10-1(2005-10) , Power transformers - Part 10-1: Determination of sound levels - Application guide;
j) IEC 60076-11(2004-05) , Power transformers - Part 11: Dry-type transformers;
k) IEC 60905(1987-12) , Loading guide for dry-type power transformers;
l) IEC 60529 (2001-02) , Degrees of protection provided by enclosures (IP Code);
m) IEC 60068-2-30(2005-08) , Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle);
n) IEC 60068-2-11(1981-01) , Environmental testing - Part 2: Tests. Test Ka: Salt mist;
o) IACS UR E10;
p) RO Framework Document for the Mutual Recognition of Type Approval.

8. MAINTENANCE / CLARIFICATION OF TECHNICAL REQUIREMENTS

Anyone wishing to propose changes to this document or request clarification of technical issues should contact the EU RO MR Group Secretariat in the first instance: Secretariat@euromr.org.

Review and approval of change requests shall follow the EU RO MR Maintenance Process detailed in the EU RO Framework Document for the Mutual Recognition of Type Approval: http://www.euromr.org/Guidance%20for%20Mutual%20Recognition.

- END -